A. Growth or Decay

1) Growth

since $b = 3$ which is bigger than 1

2) Decay

since $b = \frac{1}{3}$ which is smaller than 1

3) Growth

Since $b = 2$ which is bigger than 1

4) Decay

Since $b = 0.7$ which is smaller than 1

5) Growth

Since $b = 1.2$ which is bigger than 1

6) Decay

since the y-values in the table are getting smaller

7) Growth since the y-values are getting bigger as I read the graph from left to right

B. % Growth + Decay - Word Problems

1) A. Growth because the problem says the money appreciates

B. $y = 250(1.05)^x$

$a = \$250$ since that's the amount of \$ I start with

$b = 100\% + 5\% = 105\% \Rightarrow 1.05$ as a decimal

Plug this a and b into $y = a \cdot b^x$

C. $\approx \$335.02$

plug in $x = 6$

$y = 250(1.05)^6 = 335.02$

plug into calculator

2) 423 rabbits

First, write the equation

$a = 500$ rabbits at the start

$b = 100\% - 8\% = 92\% \Rightarrow 0.92$ as a decimal

subtract since they're dying → decay

So $y = 500(0.92)^x$

Then, plug in 2 for x for the 2 years

$y = 500(0.92)^2 = 423.2 \Rightarrow \approx 423$ rabbits

3) $M(y) = 8{,}500(0.86)^{\frac{y}{2}}$

$a = 8{,}500$ since that's the amount of \$ I start with

$b = 100\% - 14\% = 86\% \Rightarrow 0.86$ as a decimal

I subtract because "depreciates" means decay

* I need to make the exponent $\frac{y}{2}$ because y represents each year, but the mutual fund only depreciates every 2 years.

C. Exponent Rules

1) f^{11} - Add the exponents $f^8 f^2 f^1$ $8+2+1=11$

2) $3y^3$ - Subtract the exponents or $\frac{3\cancel{y}\cdot\cancel{y}\cdot y\cdot y\cdot y}{\cancel{y}\cdot\cancel{y}} = 3y^3$

3) $25h^8$ - Distribute the second power to each piece. Multiply the exponents for power to a power

or $(5h^4)^2 = (5h^4)(5h^4) = 5 \cdot 5 \cdot h^4 \cdot h^4 = 25h^8$

4) $\frac{1}{r^5}$ For negative exponents, move the piece across the fraction bar and change the sign on the exponent

5) 1 Anything to the zero power equals 1

6) $3x^2+5x$ - Already simplified. There are no like terms.

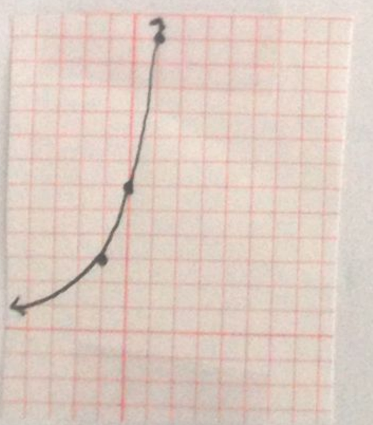
7) $3x^3$ - Combine like terms. (Don't change the exponent!)

D - Graphing Exponential Functions

- For these, create a table by hand or use $\boxed{2^{nd}}$ $\boxed{\text{Graph}}$ to get to the table on your graphing calculator.

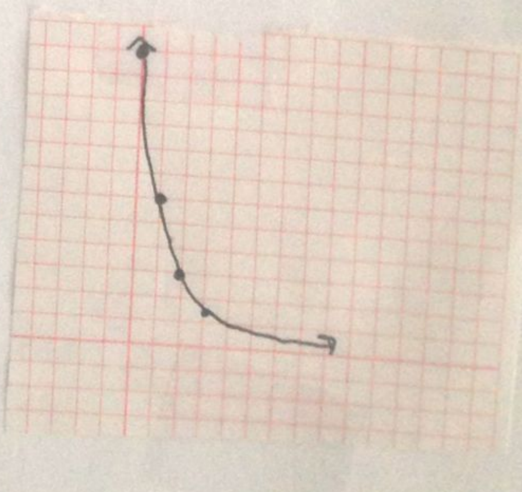
1)

x	y	
-1	3	
0	6	$y \times 2$
1	12	$y \times 2$
2	24	



2)

	x	y	
	-1	24	
a	0	12	$y \times \frac{1}{2}$
	1	6	
	2	3	$y \times \frac{1}{2}$



5. Solving Exponential Equations

1) $x = 0$

$4^{7x+2} = 16$

$4^{7x+2} = 4^2$ - Rewrite 16 to have the same base as the other side

$7x + 2 = 2$ - Set exponents equal

$-2 \quad -2$

$7x = 0$ - Solve the equation

$\frac{7x}{7} = \frac{0}{7}$

$x = 0$

2) $x = 2$

$3^{-x+2} = 1$

Need bases the same → $3^{-x+2} = 3^0$

Set exponents = → $-x + 2 = 0$

$+x \quad +x$

$2 = x$

3) $x = \frac{1}{2}$

$9^{x+2} = 9^{3x+1}$

$x + 2 = 3x + 1$ - Just set exponents = since bases are already the same

$-x \quad -x$

$2 = 2x + 1$

$-1 \quad -1$

$1 = 2x$

$\frac{1}{2} = \frac{2x}{2}$

$x = \frac{1}{2}$

4) $x = -\frac{1}{2} = -0.5$

$5^{6x} = \frac{1}{125}$ ← Fraction means the exponent will be negative

$5^{6x} = 5^{-3}$

$6x = -3$

$\frac{6x}{6} = \frac{-3}{6}$

$x = -\frac{3}{6} = -\frac{1}{2}$

5) $x = -2/7$

$4^{x-1} = 8^{3x}$ Need to rewrite both sides as powers of 2

$(2^2)^{x-1} = (2^3)^{3x}$

$2^{2x-2} = 2^{9x}$ - Multiply exponents to simplify

$2x - 2 = 9x$ - Set exponents =

$-2x \quad -2x$

$-2 = 7x$

$\frac{-2}{7} = \frac{7x}{7}$

F. Using Graphing Calc

1)

x	-2	-1	0	1
$y = f(x)$	1.0625	1.25	2	5

Put $4^\wedge x + 1$ in calc and hit $\boxed{2^{nd}}$ $\boxed{\text{Graph}}$

2)

x	-2	-1	0	1
$f(x)$	1	-1	-2	-2.5

Put in $2 \wedge -x \; -3$

negative button (−)

subtraction key

G. Modeling - Word Problems

1) A. Growth - She's getting bigger

B. $h(m) = 5(2)^{\frac{m}{9}}$

$a = 5$ ft. - her starting height

$b = 2$ since she's doubling in size

$\frac{m}{9}$ - you need to divide by 9 since she only doubles every 9 minutes (not every minute)

C. 20 ft

plug in 18 for m

$h(18) = 5(2)^{\frac{18}{9}} = 5(2)^2 = 20$

2) 15 or 16 bacteria

First, write an equation

$a = 1{,}000$ bacteria to start

$b = 1/2$ since half of the bacteria die off + 1/2 are left

$y = 1{,}000(\frac{1}{2})^x$

Then, plug in 6 for the 6 hours

$y = 1{,}000(\frac{1}{2})^6 = 15.625$

H. Writing Equations from a Table

1) $y = 20\left(\frac{1}{4}\right)^x$

or $y = 20(0.25)^x$

$a = 20$ since the table has the point $(0, 20)$

$b = \frac{1}{4}$ because I'm dividing by 4 to go from one y-value to the next, which is the same as multiplying by $1/4$

or $\frac{5}{20} = \frac{1}{4}$

2) $y = 10(2)^x$

$a = 10$ since the table has the point $(0, 10)$

$b = 2$ since I multiply by 2 to go from one y-value to the next

or $\frac{20}{10} = 2$

I. Writing Equations Given 2 Points

1) $y = 4 \cdot 6^x$

$(0, 4)$ gives me that $a = 4$

Since the x-values are consecutive (0 then 1), I can just find b by saying $4 \times 6 = 24$

2) $y = 8\left(\frac{1}{2}\right)^x$

or $y = 8(.5)^x$

$(0, 8)$ gives me that $a = 8$

I need to plug in x and y and solve for b because the x's aren't consecutive

$y = a \cdot b^x$

$y = 8 \cdot b^x$ From $(2, 2)$ $x = 2$ $y = 2$

$2 = 8 \cdot b^2$

$\frac{2}{8} = \frac{8 \cdot b^2}{8}$

$\sqrt{\frac{1}{4}} = \sqrt{b^2}$ or $\sqrt{.25} = \sqrt{b^2}$

$b = \frac{1}{2}$ or $b = .5$

3) $y = \frac{7}{3}(3)^x$

or $y = 2.\overline{3}(3)^x$

I can find b since the x-values are consecutive, but I need to solve for a since they didn't give me a point with x = 0

x	y
0	7/3
1	7
2	21

÷3

×3 = b

$y = a \cdot b^x$

$y = a \cdot 3^x$ (1, 7) x=1 y=7

$7 = a \cdot 3^1$

$\frac{7}{3} = \frac{3a}{3}$ $a = \frac{7}{3} = 2.\overline{3}$

4) $y = 6(1.793)^x$

I know a = 6 because of (0, 6), but need to solve for b because the x's aren't consecutive

From (4, 62) I know x=4 y=62

so $y = a \cdot b^x$

$y = 6 \cdot b^x$

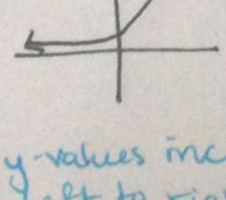
$\frac{62}{6} = \frac{6 \cdot b^4}{6}$ Now solve for b

$\sqrt[4]{10.\overline{3}} = \sqrt[4]{b^4}$ on calc: 4, Math, 5: $\sqrt[x]{\ }$, 10.333, enter

$b \approx 1.793$

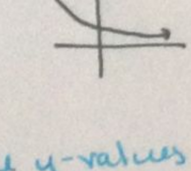
J. Graph Shape

1)



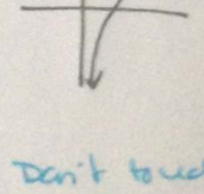
The y-values increase from left to right. Don't touch or cross the x-axis.

2)

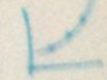


The y-values decrease from left to right. Don't touch or cross the x-axis.

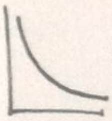
3)



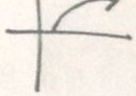
Don't touch or cross the y-axis (Can put Y= log x in your calculator to see the shape)

4) (B) $n = 2^t$ 

The graph looks exponential is shape and has y-values that are doubling. (B) is the only exponential equation in the bunch.

5) (C) 

Losing 15% of its value is an example of exponential decay. (C) is the only one that looks like an exponential decay graph

6) (C) 

They said that the cells increase <u>logarithmically</u>. (C) is the only graph that is shaped like a log graph. (See #3 on this section)

K. Even More Modeling

1) $p(x) = 75{,}000\,(0.913)^x$

$a = 75{,}000$ since that's the # of deer at the first census

This is like the point $(0, 75{,}000)$

They say 2 years later there are 62,500 deer. This is like the point $(2, 62{,}500)$. I'll use these #s for x and y.

Plug in a, x and y then solve for b.

$$y = 75{,}000 \cdot b^x$$

$$\frac{62{,}500}{75{,}000} = \frac{75{,}000 \cdot b^2}{75{,}000}$$

$$\sqrt{.833} = \sqrt{b^2}$$

$$b \approx .913$$

2) $f(n) = 300(3)^{\frac{n}{4}}$

$a = 300$ - # bacteria I start with

$b = 3$ - My population is tripling

$\frac{n}{4}$ - divide the exponent by 4 because the tripling only happens every 4 hours

3) $f(n) = 4,500(0.92)^n$

$a = 4,500$ since that's the amount of waste they start with

$b = 100\% - 8\% = 92\% \Rightarrow 0.92$ as a decimal

subtract because they are reducing their waste output = decay

4) $v = 35,000(0.78)^{10}$

$a = \$35,000$ - start value of the car

$b = 100\% - 22\% = 78\% \Rightarrow 0.78$ as a decimal

depreciating is decay → so subtract

The exponent is my # years so I plug in the 10 there.

L. Logarithm Basics

1) $7^2 = 49$

$\log_7 49 = 2$

base = exponent

2) $5^3 = x$

$\log_5 x = 3$

base = exponent

3) $10^3 = 1,000$

$\log 1,000 = 3$ ← exponent

when no # is written, the base is 10

4) $x^y = a$

$\log_x a = y$

base exponent

5) $\log_4 64 = 3$

$4^3 = 64$ ← exponent

base

6) $\log_8 1 = x$

$8^x = 1$ ← exponent

base

7) $\log y = x$

8) $\log_x h = c$

M. Using Logarithms

1) $5^0 = x + 2$

$x = -1$

$\underset{\text{base}}{\log_5}(x+2) = \overset{\text{exponent}}{0}$

$\Rightarrow 5^0 = x + 2$

$$\begin{aligned} 1 &= x + 2 \\ -2 & \quad\;\; -2 \\ \hline -1 &= x \end{aligned}$$

2) A. $\log 1{,}000$

When logs are added, multiply what's inside

$\log 10 \cdot 100 = \log 1{,}000$

B. $\log 0.1$ or $\log \frac{1}{10}$

When logs are subtracted, divide what's inside

$\log \frac{10}{100} = \log \frac{1}{10}$

C. $\log 10^{10}$

When there is a # in front of the logarithm, it becomes the exponent

D. $\log 10 \cdot \log 100$

We don't have a rule for if the logarithms are multiplied together. I put this one on here because it's one of the nonsense answers on a multiple choice question and I wanted to point out that it won't be the right answer.